One prior art solution to this problem is the use of compound grease. This grease lubricates the threads, thus preventing seizing. However, the prior art compound greases are laden with heavy metals, and present an environmental problem by their presence in the workplace. In addition, since the grease often exudes during the making up process, cleaning is required and the aftermath of the cleaning must also be dealt with in an environmental way.

In response to the problems with these compound greases, solid lubricant coatings were developed that used a resin and a molybdenum or tungsten disulphide, see page 2, lines 20-25 of the specification. Other solutions are also described on page 2, wherein an undercoating is employed, or a combination of an undercoating and a nitride layer, or a combination of an undercoating, an iron layer, and a nitride layer.

Since drilling is being done at increasing depths, the drilling operating temperatures are increasing, and threaded joints using some form of a solid lubricating coating are still found to be inadequate in their seizing resistance. One problem with the use of solid lubricating coating is that an interface exists between the steel substrate and the solid lubricating coating. Because of this clear interface and the difference in thermal expansion properties of the substrate and the solid lubricant coating, the coating can peel off, thus compromising its lubricating properties. Also, the coatings are still susceptible to galling and seizing during repeated fastening and unfastening.

The solution combining the nitride layer, iron layer and solid lubricating coating is problematic in the complexity of the process to make such a composite layer.

While the use of compound grease could solve the problems faced by the prior art, the environmental concerns preclude its use as an anti-seizing material for use in

these types of threaded joints.

INVENTION

The invention solves the problems faced by the prior art by creating a joint that has better seizing resistance. First, the invention provides a porous undercoating for a solid lubricating coating, whereby the solid lubricating coating can penetrate the undercoating so as to remove the clear interface in the prior art.

The invention also entails the use of a liquid lubricant coating on the undercoating layer that does not have any heavy metal powders, thus eliminating the environmental problems noted above.

REJECTION

In rejecting the claims, the Examiner cites Kawashima to allege that it is known to provide a metallic coating layer having a porosity of 5-80% and a thickness of 1-30 microns, and a liquid lubricating coating thereon, with the total thickness being less than 100 microns. Kawashima is representative of the prior art discussed above, wherein a compound grease is employed. In fact, the true advancement of Kawashima is in the particular blast-plated layer. The addition of the lubricant follows the conventional approach, i.e., a conventional and heavy metal-containing lubricant is employed, see col. 4, lines 40+.

The Examiner admits that the threaded joint of Kawashima does not address the claim limitation that heavy metal powders are absent from the liquid lubricant coating. In response to this deficiency, the Examiner cites Tsuru, and particularly points to the discussion of two prior art Japanese publications in col. 2, lines 48-68. In this passage, Tsuru states "It is attempted to develop compound grease containing no

heavy metal and put it on the market." The Examiner relies on this statement to conclude two things essential for supporting the rejection under 35 USC §103(a). First, the Examiner assumes that a compound grease without heavy metals was developed, and second, that it would then be obvious to employ such a grease in substitution of the grease used in the Kawashima joint.

The Examiner also considers claims 2, 3, 7, 8 and 10 to be taught by Kawashima as they relate to the features of the undercoating.

Regarding claims 6 and 10, the Examiner alleges that col. 21 of Tsuru teaches the use of a solid binder in a solid lubricating coating, and that these claims are obvious.

Claims 5 and 9 are rejected under 35 USC §103(a) based on the combination of Kawashima and Tsuru when modified by United States Patent No. 3,625,893 to Brook. In this rejection, the Examiner alleges that Brook teaches the claimed lubricant, and that it would have been obvious to use the Brook lubricant in the joint of Kawashima/Tsuru.

ARGUMENTS

Applicants contend that the cited prior art does not establish a *prima facie* case of obviousness against claim 1.

Critical to the Examiner's rejection is the assumption that Tsuru teaches the use of a compound grease that has no heavy metals. It is respectfully submitted that Tsuru does not stand for this assumption, and lacking such a teaching, there is no reason that one of skill in the art would modify Kawashima as alleged in the Office Action.

Examining Tsuru more closely, the invention of Tsuru is the removal of the prior

art lubricant without the loss of galling resistance, see col. 3, lines 20-25. This is accomplished by the use of a solid lubricant coating on a phosphate coating. Tsuru mentions compound grease in terms of the prior art, and recognizes its environmental problems, see col. 2, line 63. However, there is no clear disclosure of a compound grease without heavy metals. At most, Tsuru suggests that it would be nice to have one. Even recognizing the environmental problem with compound greases, Tsuru does not explore a non-heavy metal grease. Instead, Tsuru develops a solution where the grease is entirely eliminated. Therefore, the overall point of Tsuru is that the grease should be eliminated.

This still leaves the question of what are the teachings of the two Japanese publications cited on col. 2 of Tsuru. For the Examiner's benefit, an English version of 6-11078 is attached herewith. As the Examiner will see, this reference has nothing to do with the development of a heavy metal-free grease, and it is merely cumulative to the cited prior art in discussing the use of a compound grease having metal as a principal component, see paragraph [0004]. The invention of 6-11078 is in a particular thread configuration. The disclosure of 6-11078 does not provide an objective basis to conclude that it would be obvious to employ a grease without heavy metal in the Kawashima joint. Accordingly, the Examiner cannot rely on this disclosure to support the rejection.

An English version of the other Japanese publication, No. 63-210487 is unfortunately unavailable. However, Applicants have reviewed this publication and can attest that this publication is similar to 6-11078 in that there is no mention of any environmental problem or mention of the nature of the grease in terms of containing heavy metals or not. Therefore, this publication is also deficient in its teachings regarding the use of a compound grease that lacks heavy metals for joint use.

Given that each of the Japanese publications cited in Tsuru do not actually suggest the use of a compound grease lacking heavy metals, the Examiner is left with relying on the disclosure of Tsuru itself to substantiate the rejection under 35 USC §103(a). In this regard, the question of obviousness is two fold. First, does Tsuru suggest to one of skill in the art that a compound grease without heavy metals could be used in Kawashima? Secondly, if the answer to this question is yes, what grease would it be?

Applicants assert that there is no suggestion to use a compound grease without heavy metals as part of the Kawashima system. There is no disclosure in Tsuru as to the actual use of a liquid lubricating composition that does not have heavy metals. At most, Tsuru expresses a need for such a composition. However, this need alone does not obviate the invention. As required by 35 USC §103(a), the Examiner must have an objective basis in fact to support any rejection. The mere speculation of Tsuru is insufficient to arrive at the invention.

Put another way, how would one of skill go about using a compound grease without heavy metals in Kawashima? In order to do so, one of skill in the art would first have to have a compound grease that does not have substantial heavy metals in it. Where in the cited art is there even a hint of such a product. There is no basis to conclude that such a product even exists in order to say that it would be obvious to use it in Kawashima. In fact, Tsuru in col. 2, line 65 to col. 3, line 3, suggests the contrary. While indicating that it would be ideal to eliminate the compound grease, Tsuru admits that with the current state of the art it cannot be done. In the face of this dilemma, Tsuru solves the problem by providing a joint that does not require the conventional liquid lubricant used to coat the joint prior to the making up process, see col. 3, lines 55-60. The only reasonable conclusion that can be drawn from this

statement is that Tsuru is referring to the known greases that contain heavy metals in his teachings and makes no disclosure of the ability to solve the problem in the manner achieved by the present inventors.

As stated above, Tsuru teaches the combination of a phosphate film and a solid lubricant coating containing heavy metals as a substitute for the conventional grease. There is absolutely no suggestion of using a compound grease that would not have substantial heavy metals in it.

Therefore, the Examiner's assumption that Tsuru teaches that it is known to use compound greases that do not contain substantial amounts of heavy metal is in error. Since there is no teaching in this regard, there can be no motivation to modify Kawashima as asserted in the outstanding Office Action, and the rejection is fatally flawed and must be withdrawn.

Furthermore, since Kawashima is concerned with the use of a liquid lubricant, and Tsuru seeks to eliminate such a lubricant, one of skill in the art would not be motivated to combine the two patents.

It should also be noted that the solid lubricating coating of Tsuru uses heavy metals, e.g., copper and zinc, and that Tsuru, while noting that heavy metals cause environmental problems, does not eliminate them from this coating.

In summary, it is respectfully submitted that claim 1 is not obvious under 35 USC §103(a) because there is no suggestion to modify Kawashima as alleged in the outstanding Office Action.

The rejection is also flawed with respect to claims 6 and 10. In the rejection, the Examiner contends that because Tsuru teaches a particular solid lubricant having a binder, this teaching obviates claims 6 and 10. This position is fundamentally incorrect. Claims 6 and 10 claim the combination of the porous undercoating layer

and a solid lubricant coating. The mere fact that Tsuru teaches a solid lubricating coating that has a binder does not by itself render claims 6 and 10 obvious. To backtrack, the Examiner's rejection is based on Kawashima's teaching of combining a liquid lubricant with the porous layer. Claims 6 and 10 claim the combination of a porous layer and a solid lubricant coating. This combination is not suggested by Kawashima, there is no solid lubricant coating in Kawashima.

Moreover, just because Tsuru teaches a solid lubricant coating with a binder does not mean that it would be obvious to use such a lubricant in place of the liquid lubricant of Kawashima. In fact, one of skill in the art would be led away from such a modification. The porous layer of Kawashima is designed to take up the liquid lubricant. Why then use solid lubricant on such a layer? This goes directly against the thrust of Kawashima, and any such modification can only be the hindsight reconstruction of the prior art in light of Applicants' disclosure. Therefore, claims 6 and 10 are separately patentable over the applied prior art.

The Brook reference does not make up for the deficiencies in the rejections outlined above. Brook is merely representative of a liquid lubricant. More particularly, Brook is directed to the problem of corrosion in engines as a result of sulfur compounds. To alleviate this problem, engine lubricating oils are modified with additives to neutralize acidic fuel combustion products. However, these additives do not provide sufficient oxidation stability and antirust properties. Brook solves this problem by creating a liquid lubricating composition that employs a mixture of basic Group II metal salts.

There is nothing in the teachings of Brook that would tell one of skill in the art to use the Brook composition as a liquid lubricating composition in the joint of Kawashima. To draw such a conclusion is also the use of hindsight, employing

Applicants' invention as a teaching template. Since there is absolutely no reason to use the composition of Brooks in Kawashima, the Examiner has failed to establish a *prima facie* case of obviousness against claims 5 and 9, and these claims stand alone as being patentable.

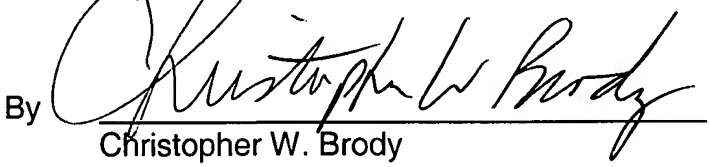
If an interview would expedite allowance of this application, the Examiner is invited to telephone the undersigned at 202-835-1753.

The above constitutes a complete response to the Office Action of August 9, 2004.

Again, reconsideration and allowance of this application is respectfully solicited.

Applicant respectfully petitions for a one month extension of time in this application to extend the deadline for filing until December 9, 2004. A check in the amount of $110.00 is attached, however, please charge any fee deficiency or credit any overpayment to Deposit Account No. 50-1088.

Respectfully submitted,
CLARK & BRODY

By 
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Docket No.: 12014-0019
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PATENT ABSTRACTS OF JAPAN

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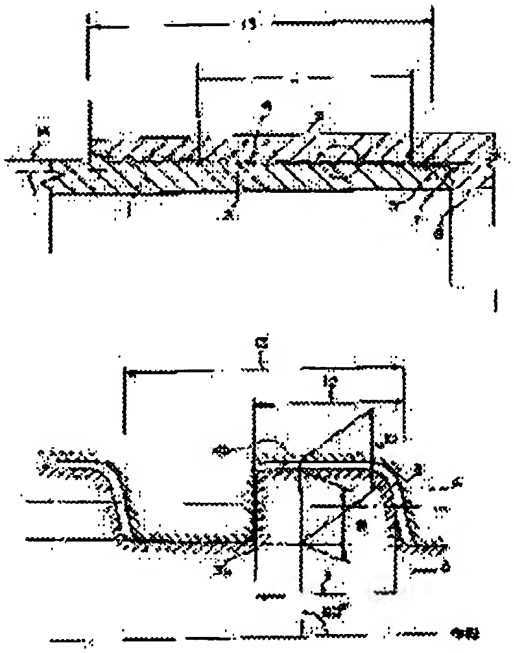
(71)Applicant : KAWASAKI STEEL CORP
(72)Inventor : YAMAMOTO KENICHI

(54) THREADED JOINT FOR OIL WELL PIPE

(57)Abstract:
PURPOSE: To provide a special threaded joint for an oil well pipe of which reliability for leakproof property is remarkably improved.
CONSTITUTION: The outer cicumference of the extreme end part of a steel pipe 1 is provided with a tapered part 14 toward the extreme end, external thread 3 is carved thereon, and a seal part 5 is formed on the extreme end. A coupling 2 is formed with internal thread on the inner circumferential face, and seal part 6 capable of being engaged with the seal part 5 of the steel pipe 1. The thread part of the steel pipe 1 and the coupling 2 is formed into trapezoidal screw thread, and in the threadedly engaged condition, a decided clearance 8 is generated between the thread ridge 3a of the steel pipe 1 and the thread groove 4b of the coupling 2. By changing the height 9 and the width 11 of the thread ridge 3a of the external thread 3, and the depth 10 and the width 12 of the thread groove 4a of the internal thread 4, the disoharge resistance of compound is reduced so as to be in a range under 7000mm-1.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

CLAIMS

[Claim(s)]
[Claim 1] In the oil well pipe thread joint equipped with the metal seal section and the screw section following it Receive the cross section which met the axis of the clearance formed between the complete threads of the male screw and female screw which were screwed in the above-mentioned screw section when concluding tubing and coupling. The oil well pipe thread joint with which the ratio of the screw thread die length spirally measured along with the screw thread in the length of fit of the screw section is characterized by making it become one or less [7000mm -].

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the screw joint used for mining of petroleum gas etc., and relates to the oil well pipe thread joint which has the description especially in the screw configuration engraved.
[0002]
[Description of the Prior Art] an exhaustion of recent years and a resource, or an advance of a digging technique — following — a stone — the oil well which development of an oil well or a gas well is furthered more under an elevated-temperature hyperbaric atmosphere, and is used for it — the property required of tubing is also severe much more. In the screw configuration of the screw section in the screw joint which connects the Yui tubing It is API (AmericanPetroleumInstitute: American Petroleum Institute) specification API:Specification from the former. STD A round screw configuration (drawing 3 (b)), a buttress screw configuration (drawing 3 (a)), etc. of 5B in the screw section a seal function Although the screw joint of the given structure has been used widely There is a problem in respect of the leak-proof nature under elevated-temperature high pressure, joint tensile strength, and galling generating in the screw section according to bolting and a looser repeat further, and it is in the inclination for the special screw joint which has a property superior to the screw configuration of Above API to be used.
[0003] As the special screw joint for Yui tubing, there are some which are indicated by JP,1-12995,B etc., for example, and as shown in drawing 1 , the seal is determined from the property of joint tensile strength that the screw section 15 is required rather than a seal function, on the basis of the metal seal by the tip 5 of a steel pipe 1, and metallic contact between the torque shoulder sections 6 of coupling 2. And since the buttress screw configuration is superior to the round screw configuration as joint ****** among two kinds of screw configurations specified by the above-mentioned API specification, the buttress screw configuration, i.e., the screw configuration of trapezoidal shape, is widely adopted as the special screw joint.
[0004] and in case the special screw joint is concluded The lubricant which uses the grease called a compound, zinc, lead, etc. as a principal component It applies to the whole surface of the male screw section 3, the tubing tip 5, the female screw section 4, and the torque shoulder section 6, or a part beforehand. As opposed to the metal seal section 7 in which a worker is first formed after bolting (it is henceforth called hand tightness) in a steel pipe 1 and coupling 2 by human power in the tip 5 of a steel pipe 1, and the torque shoulder section 6 of coupling 2 It is binding tight to predetermined torque with the conclusion machine until contact planar pressure required to secure the desired leak-proof engine performance arises.
[0005] The path clearance between the screwed male screw 3 and a female screw 4 to drawing 4 (a) like [if the **** configuration is completely the same as that of the buttress screw of API specification] under the present circumstances, since it is very small While the applied compound binding tight, and being at the termination time, depositing between a male screw 3 and a female screw 4 and on the metal seal section 7 neighborhood, and the pressure called dope ** as a result arising in the metal seal section 7 and having a bad influence on the seal

engine performance Since galling occurs in the screw section 15 by bolting and the looser repeat, in the conventional special screw joint, as shown in drawing 4 (b), a part of buttress configuration is corrected, and it is made a screw configuration by which the predetermined path clearance 8 is formed between the male screw 3 in a conclusion condition, and a female screw 4.

[0006] In addition, only in ******, such as petroleum gas, the above-mentioned conclusion activity is done, also when attaching and shipping coupling 2 to a pipe at tubing 1 edge in a plant.

[0007]
[Problem(s) to be Solved by the Invention] As mentioned above, although it is binding tight to predetermined torque value with the conclusion machine after applying and carrying out the hand tightness of the lubricant called a compound on the occasion of the conclusion activity of a special screw joint, the bolting torque is classified into the torque called the shoulder torque produced by interference with the male screw 3 of tubing 1, and the female screw 4 of coupling 2, and the torque called the delta torque beyond it (an A point or subsequent ones) as shown in drawing 5 .
[0008] although it be the latter delta torque torque be contribute to the leak-proof nature of a special screw joint among this torque, it have the relation of the increment in monotone as indicate to be the contact planar pressure produce in this delta torque and the metal seal section to drawing 6 , and since desired contact planar pressure be obtain by store this delta torque in the fitness range, efforts to suppress dispersion in shoulder torque so that this delta torque may fall within a fixed range conventionally have be make.
[0009] As a factor in which this shoulder torque is changed sharply, conventionally, dispersion within the tolerance of product of the amount of screw interference, the class of compound to be used, the surface-preparation conditions of a screw side, the machining granularity of a screw side, etc. are known widely, and measures as shown below in the former were taken.
(1) Friction Factor of the optimization (2) compound of the tolerance zone of tubing and a coupling screw dimension Even if it took the dispersion prevention, however the above-mentioned cure of screw processing side roughness by standardization of the standardization (4) screw-cutter conditions of the modification (3) surface-preparation conditions of conclusion torque value of having responded, in the former, it was difficult to, store dispersion in the shoulder torque at the time of bolting of a special screw joint within fixed limits in addition. And there was a problem that there was a danger that desired delta torque may not be secured and leak will occur from a joint part with the lack of contact planar pressure of the metal seal section 7 under a severe environment, by changing this shoulder torque sharply.
[0010] This invention was made paying attention to the above troubles, suppresses the variation in the above-mentioned shoulder torque, and aims at offering the special screw joint for Yui tubing which raised the dependability over leak-proof nature remarkably.
[0011]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the oil well pipe thread joint of this invention In the oil well pipe thread joint equipped with the metal seal section and the screw section following it Receive the cross section which met the axis of the clearance formed between the complete threads of the male screw and female screw which were screwed in the above-mentioned screw section when concluding tubing and coupling. The ratio of the screw thread die length spirally measured along with the screw thread in the length of fit of the screw section is characterized by forming so that it may become one or less [7000mm -].
[0012]
[Function] As shown in drawing 4 , the thing of the same screw configuration (drawing 4 (a)) as the buttress screw of API specification, The conventional special screw joint of the screw configuration (drawing 4 (b)) which processed a part of buttress screw and formed the predetermined path clearance 8 between the male screw 3 and the female screw 4 so that the effect of dope ** might be removed at the time of conclusion All, such as the amount of screw interference, machining granularity of a screw side and surface treatment, and a compound to be

used, are set as the same conditions, and if it asks for the torque-turn curve at the time of the conclusion of these screw joints which has the metal seal section, it will become like drawing 7 and drawing 8 .

[0013] In addition, drawing 7 is the thing of the screw joint of the screw configuration of API specification, and drawing 8 is the thing of the conventional special screw joint. As shown in this drawing, it is 4rpm – 20rpm about a bolting rate. When it is made to change in the range, in the screw joint of API specification, it turns out that it is remarkably influenced by the bolting rate in the conventional special screw joint to being almost fixed shoulder torque value, and shoulder torque value is small, so that that bolting rate is early, without almost receiving effect in a bolting rate.

[0014] Thus, it turns out that the effect on the shoulder torque value over a bolting rate is remarkably different with the difference in a design, and it influences strongly also in the same screw configuration of trapezoidal shape in adopting the screw section of the correction buttress configuration especially adopted as the special screw joint widely. In addition, even if these facts take the cure of said conventional (1) – (4), it is thought that it is the big cause of in addition changing shoulder torque sharply.

[0015] above -- all the screw dimensions and contact surfaces — similarly a setup of description etc. is not involved but shoulder torque value's changing with the bolting rates in a special screw joint is exactly coefficient of friction in the contact surface of the male screw of tubing and the female screw of coupling binding tight, and changing on conditions. And the compound currently used as lubricant depends for this coefficient of friction on how much it remains between touch areas.

[0016] Like the screw joint of API specification, namely, when the path clearance between a male screw and a female screw is very small Although it became fixed [lubrication conditions] regardless of the bolting rate and the value of shoulder torque is stable since it is difficult to discharge the compound which exists between screw sides in the hand tight condition outside at the time of bolting When predetermined path clearance is formed between the male screw and the female screw like the conventional special screw joint, it is because the compound which originally exists in a screw side consists is easy to be discharged of between the contact surfaces of a screw outside in the hand tight condition at the time of bolting. And since it will bind tight if a bolting rate is slow, and time amount becomes long, as a result of the amount of the compound discharged outside increasing and coefficient of friction in the contact surface increasing, the value of shoulder torque becomes high. On the other hand, if a bolting rate is early, since bolting time amount will become short, it can be presumed that discharge of a compound decreases, coefficient of friction in the contact surface becomes small, and the value of shoulder torque becomes low.

[0017] In order to evaluate these phenomena quantitatively, its attention was paid to the ratio of the screw thread die length Lc spirally measured along with the screw thread in the fitting part to the cross-sectional area Sc which met in the direction of an axis of the clearance part which consists of a complete thread of the male screw after conclusion, and a complete thread of a female screw in this invention. It is thought that the degree of the resistance to the compound in a hand tight condition which comes out and exists in a fitting part binding tight, and beginning to see outside by this ratio in inside can be evaluated. This ratio can be expected that a compound becomes is hard to be discharged, so that the screw structure Sc, i.e., the above-mentioned cross-sectional area, where that discharge resistance (Lc/Sc) is strong is small or the above-mentioned screw thread die length Lc is long, when it is henceforth called discharge resistance (Lc/Sc) of a compound.

[0018] The screw configuration was changed, the above-mentioned cross-sectional area and screw thread die length were actually changed, and when asked for change of the shoulder torque value when binding tight to predetermined torque value at some bolting rates, the result as shown in drawing 9 was obtained. In addition, it sets to drawing 9 and is bolting rate 4rpm to an axis of ordinate. 20rpm The value of the discharge resistance (Lc/Sc) of the above-mentioned compound by the variation of shoulder torque value on an axis of abscissa is taken.

[0019] If the variation of shoulder torque becomes large and becomes to fixed level beyond a

certain value, it will become small conversely and will serve as a value final almost near zero, as shown in this drawing and the above-mentioned discharge resistance (Lc/Sc) becomes large. Moreover, although fixed level is large with reduction of discharge resistance (Lc/Sc), if the variation of the above-mentioned shoulder torque becomes below a certain value, it becomes small conversely and serves as a value final almost near zero.

[0020] In addition, the location (B) where the above-mentioned discharge resistance (Lc/Sc) becomes 30,000 shows the condition of the screw configuration of the screw joint of API specification. although a compound will become is hard to be discharged outside regardless of a bolting rate and shoulder torque will serve as constant value if the above-mentioned result has extremely strong discharge resistance (Lc/Sc), it means being easy to be discharged conversely, whenever discharge resistance (Lc/Sc) is extremely small, binding tight also in this case, and becoming the value of about 1 law regardless of a rate.

[0021] Moreover, this inclination also checked that it could treat systematically with the above-mentioned discharge resistance (Lc/Sc) value, without being dependent on an outer diameter, thickness, etc. of a screw joint. Here discharge resistance (Lc/Sc) as mentioned above in an extremely large screw configuration, i.e., the buttress screw configuration of API specification Since the bad influence to the seal engine performance resulting from dope ** near the metal seal section after generating of galling to the screw section at the time of bolting or conclusion poses a problem, it sets to this invention. A screw configuration is formed so that the above-mentioned discharge resistance (Lc/Sc) whose fluctuation of shoulder torque discharge resistance (Lc/Sc) is small and is a location (A) almost near zero may be set as one or less [7000mm -] value from the result of drawing 9 .

[0022] Thus, in the special screw joint equipped with the designed screw section, it can conclude so that the shoulder torque resulting from the difference in the model of conclusion machine etc. stabilized without having bound tight and receiving effect in a rate and the delta torque of further a request may be acquired. In addition, in the special screw joint of this invention, although it is easy to be discharged in case the compound which is between screw sides in the hand tight condition is bolting, the these-discharged compound is superfluous for original lubricity, and there is no bad influence to galling generating of the screw section.

[0023]

[Example] The example of this invention is explained based on a drawing. If a configuration is explained first, the basic configuration is the same as said conventional special screw joint, as shown in drawing 1 , the point periphery of a steel pipe 1 has the taper 14 which serves as a minor diameter towards a tip, a male screw 3 is engraved, the screw section 15 is formed, and the seal section 5 by the side of the tubing 1 following the screw section 15 is formed at the tip.

[0024] While the female screw 4 which coupling 2 screws [the male screw 3 of the above-mentioned steel pipe 1 and] in inner skin is formed, the seal section 5 of the above-mentioned steel pipe 1 and the seal section 6 by the side of the coupling 2 which can be engaged are formed, and the metal seal section is constituted by both seal sections 5 and 6. Moreover, as shown in drawing 2 , it is a trapezoidal thread, and the screw configurations of the above-mentioned steel pipe 1 and coupling 2 are constituted in the condition of having screwed, as the predetermined path clearance 8 occurs among screw slot 4b of screw thread 3a of a steel pipe 1, and coupling 2.

[0025] And the cross section Sc of the path clearance 8 which met the axis in length of fit L between complete threads by changing the height 9 and width of face 11 of screw thread 3a of a male screw 3, and the depth 10 and width of face 12 of screw slot 4a of a female screw 4 is made to increase conventionally. Or when the screw pitch 13 or the screw taper 14 changes, the screw thread die length Lc spirally measured along with the screw thread in the above-mentioned length of fit L is decreased conventionally.

[0026] By this, discharge resistance (Lc/Sc) of a compound is made small and it is made one or less [above / 7000mm -] range. When the screw joint to Yui tubing with L80, an outer diameter [of 139.7mm], and a thickness of 7.72mm was actually processed by API specification and the bolting activity was done on the same conditions, the result as shown in Table 1 was obtained.

[0027]

[Table 1]

継手 No.	雄ネジ寸法		雌ネジ寸法			ネジ部クリアランス	ネジ山長さ	排出抵抗	ショルダートルク
	ネジ山高さ (mm)	ネジ山幅 (mm)	ネジ山高さ (mm)	ネジ底幅 (mm)		断面積 Sc (mm2)	Lc (mm)	Lc/Sc (1/mm)	変化量 (kg-m)
1	1.575	2.500	1.575	2.610		0.153	4475.766	29,255	0
2	1.575	2.500	1.575	2.610		0.224	4475.766	19,940	148
3	1.575	2.500	1.575	2.610		0.298	4475.766	15,035	140
4	1.575	2.500	1.575	2.610		0.369	4475.766	12,129	94
5	1.575	2.500	1.575	2.610		0.255	4475.766	17,527	149
6	1.575	2.500	1.575	2.610		0.359	4475.766	12,456	108
7	1.575	2.500	1.575	2.610		0.462	4475.766	9,694	30
8	1.575	2.500	1.575	2.610		0.218	4475.766	20,502	140
9	1.575	2.500	1.575	2.610		0.285	4475.766	15,684	143
10	1.575	2.500	1.575	2.610		0.351	4475.766	12,757	112
11	1.575	2.500	1.575	2.610		0.251	4475.766	17,857	148
12	1.575	2.500	1.575	2.610		0.350	4475.766	12,793	112
13	1.575	2.500	1.575	2.610		0.449	4475.766	9,966	35
14	1.575	2.500	1.575	2.610		0.417	4475.766	10,761	53
15	1.575	2.500	1.575	2.610		0.617	4475.766	7,258	-3
16	1.575	2.500	1.575	2.610		0.816	4475.766	5,487	0
17	1.575	2.500	1.575	2.610		0.481	4475.766	9,315	23
18	1.575	2.500	1.575	2.610		0.679	4475.766	6,595	0
19	1.575	2.500	1.575	2.610		0.875	4475.766	5,113	0

[0028] This table 1 changes the dimension of a male screw 3 and a female screw 4, and the shoulder torque variation in drawing is 4rpm about a bolting rate. And 20rpm It binds tight and the difference of the shoulder torque value at the time is expressed. [the table] [discharge resistance (Lc/Sc) of a compound] [to the screw joint which changed many things] [under the same conditions] In addition, joint No.1 is the screw joint of API specification among drawing, and the screw section path clearance cross section Sc is 2 0.153mm. Since it is small, discharge resistance (Lc/Sc) is the largest with 29000mm−1. In this joint, when having repeated bolting, galling occurred in a part of screw section 15.

[0029] Moreover, the value which front Naka in joint No.2−19 and a shadow attach In the direction which makes discharge resistance (Lc/Sc) of a compound small, by the item which changed each dimension or two or more dimensions to the above−mentioned joint No.1 Among those, joint No.16, and 18 and 19 are the screw joints formed based on this invention, and it can check that discharge resistance (Lc/Sc) of a compound has become one or less [7000mm −], and shoulder torque is fixed regardless of a bolting rate.

[0030] Moreover, in other screw joints, it turns out that the discharge resistance (Lc/Sc) value of a compound is in the range of 10000-20000mm-1 mostly, shoulder torque binds tight, and it changes sharply with a rate. Furthermore, although it restricted when it bound tight at a comparatively late rate and leak has occurred in joint No.2, and 3, 5, 8, 9 and 11 during a trial under the conditions according to API specification when the gas leak trial of the screw joint of all above is carried out To joint No.16 of the example based on this invention, and 18 and 19, it could check that leak had not occurred during a trial regardless of a bolting rate, and the effectiveness of the screw joint by this invention was checked.

[0031]

[Effect of the Invention] As explained above, by this invention, the supply of the oil well pipe thread joint which can bind tight, can suppress the effect of a rate and can acquire always almost fixed shoulder torque value which was not able to be managed strictly is attained by the former. The effectiveness that the reliability which grant of predetermined delta torque is related always attained at a bolting rate, and the contact planar pressure therefore needed at worst at leak-proof nature is always secured to the seal section by this, and hits using Yui tubing improves is acquired.

[Translation done.]